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FEE TRANSMITTAL
for FY 2005

AUG 04 2005

☐ Applicant claims small entity status. See 37 CFR 1.27**TOTAL AMOUNT OF PAYMENT (\$)** 500.00**Complete If Known**

Application Number	10/762,764
Filing Date	JANUARY 22, 2004
First Named Inventor	XI, ET AL
Examiner Name	DAVID A. ZARNEKE
Art Unit	2829
Attorney Docket No.	APPM/004714.C1/CPI/WCVD/PJS

METHOD OF PAYMENT (check all that apply)☐ Check ☐ Credit Card ☐ Money Order ☐ None ☐ Other (please identify) _____☒ Deposit Account Deposit Account Number: 50-1074/004714.C1/CPI/WCVD/PJS Deposit Account Name: Applied Materials, Inc.

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

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FEE CALCULATION**1. BASIC FILING, SEARCH, AND EXAMINATION FEES**

Application Type	FILING FEES		SEARCH FEES		EXAMINATION FEES		Fees Paid (\$)
	Fee (\$)	Small Entity Fee (\$)	Fee (\$)	Small Entity Fee (\$)	Fee (\$)	Small Entity Fee (\$)	
Utility	300	150	500	250	200	100	_____
Design	200	100	100	50	130	65	_____
Plant	200	100	300	150	160	80	_____
Reissue	300	150	500	250	600	300	_____
Provisional	200	100	0	0	0	0	_____

2. EXCESS CLAIM FEES**Fee Description**

Each claim over 20 (including Reissues)

Small Entity

Fee (\$)

Fee (\$)

Each independent claim over 3 (including Reissues)

50

25

Multiple dependent claims

200

100

Total Claims**Extra Claims****Fee (\$)****Fee Paid (\$)**

360

180

Multiple Dependent Claims

- 20 or HP = _____ x _____ = _____

Fee (\$)**Fee Paid (\$)**

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims**Extra Claims****Fee (\$)****Fee Paid (\$)**

- 3 or HP = _____ x _____ = _____

HP = highest number of independent claims paid for, if greater than 3.

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is \$250 (\$125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.18(s).

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof	Fee (\$)	Fee Paid (\$)
_____ - 100 = _____	_____	_____ / 50 = _____ (round up to a whole number) x _____	_____	_____

4. OTHER FEE(S)

Non-English Specification, \$130 fee (no small entity discount)

Other (e.g., late filing surcharge): APPEAL BRIEF**Fees Paid (\$)****\$500.00****SUBMITTED BY**

Signature	<i>Robert W. Mulcahy</i>	Registration No.	25,436	Telephone	713-623-4844
Name (Print/Type)	ROBERT W. MULCAHY	(Attorney/Agent)		Date	August 1, 2005

This collection of information is required by 37 CFR 1.138. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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Group Art Unit: 2829

Examiner: David A. Zarneke

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CERTIFICATE OF MAILING
37 CFR 1.8

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REAL PARTY IN INTEREST

The present application has been assigned to Applied Materials, Inc., 3050 Bowers Avenue, Santa Clara, California 95054.

RELATED APPEALS AND INTERFERENCES

Appellant asserts that no other appeals or interferences are known to the Appellant, the Appellant's legal representative, or assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

STATUS OF CLAIMS

Claims 16-20, 23, and 26 are pending in the application following entry by the Examiner of a Response to Final Office Action. Claims 1-14 were originally presented in the application. Claims 8 and 10 were amended and claims 15-33 were added in the Response to Office Action dated October 7, 2004, that was filed December 21, 2004. Claims 16, 23, and 26 were amended and claims 1-15, 21, 22, 24, 25, and 27-33 were canceled in the Response to Final Office Action dated March 2, 2005, that was filed May 2, 2005. Claims 16-20, 23, and 26 stand rejected in view of two cited references as discussed below. The rejection of claims 16-20, 23, and 26 based on the cited references is appealed. The pending claims are shown in the attached Claims Appendix.

STATUS OF AMENDMENTS

An amendment to rewrite claims 16, 23, and 26 in independent form and cancel claims 1-15, 21, 22, 24, 25, and 27-33 was submitted after the final rejection in the Response to Final Office Action dated March 2, 2005, that was filed May 2, 2005. The Examiner indicated that the amendment would be entered upon appeal. Arguments presented after final rejection were not accepted by the Examiner.

SUMMARY OF CLAIMED SUBJECT MATTER

Embodiments of the invention provide a method of forming a refractory metal layer that includes depositing a nucleation layer on a substrate and then depositing a bulk deposition layer on the nucleation layer, wherein the bulk deposition layer includes a compound contained in one of the gases used to deposit the nucleation layer (paragraph [0010], p. 5, lines 6-11).

In the embodiment of independent claim 16, a method of forming a nucleation layer and a bulk deposition layer on a substrate having a plurality of vias (Figure 10, paragraph [0032], p. 11, lines 9-10) is provided. The refractory metal nucleation layer is formed by serially exposing the substrate to first and second reactive gases (paragraphs [0028], whole paragraph and [0027], p. 9, lines 1-2). The refractory metal nucleation layer covers the plurality of vias (60 in Figure 10). A bulk deposition layer is then formed on the nucleation layer by vapor deposition (paragraph [0032], p. 11, lines 12-14). The bulk deposition layer is a refractory metal layer, *i.e.*, tungsten (paragraph [0032], p. 11, lines 12-13). The refractory metal of the bulk deposition layer is contained in one of the first and second reactive gases used to deposit the nucleation layer (paragraph [0010], p. 5, lines 6-11, paragraph [0028], lines 3-5, paragraph [0032], p. 11, lines 12-13). The bulk deposition layer fills the plurality of vias on the substrate (Figure 11, paragraph [0032], p. 11, lines 16-18).

In the embodiments of independent claims 23 and 26, a method of forming a nucleation layer and a bulk deposition layer on a substrate disposed in a processing chamber is provided. The refractory metal nucleation layer is formed by serially exposing the substrate to a boron-containing compound and a tungsten-containing compound (paragraph [0028], p. 9, lines 3-5). Serially exposing the substrate to the boron-containing compound and the tungsten-containing compound includes multiple cycles (paragraph [0027], p. 9, lines 1-2) of exposing the substrate to the boron-containing compound for a period of time and exposing the substrate to the tungsten-containing compound for a period of time, such as a pulse (paragraphs [0028], p. 9, lines 9-29, Figures 12 and 13). A bulk deposition layer is then formed on the nucleation layer by employing vapor deposition to deposit a refractory metal contained in one of

the boron-containing compound and the tungsten-containing compound (paragraph [0010], p.5, lines 6-11, paragraph [0028], p. 9, lines 3-5, paragraph [0032], p. 11, line 13).

GROUND OF REJECTION TO BE REVIEWED ON APPEAL

1. Claims 16-18 and 20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Kang, et al.* (U.S. Patent No. 6,139,700).
2. Claim 19 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over *Kang, et al.* (U.S. Patent No. 6,139,700) in view of *Kang, et al.* (U.S. Patent No. 6,287,965).
3. Claims 23 and 26 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Kang, et al.* (U.S. Patent No. 6,139,700) in view of *Kang, et al.* (U.S. Patent No. 6,287,965).

ARGUMENTS

1. **Argument with respect to the rejection of claims 16-18 and 20 under 35 U.S.C. § 103(a) by *Kang, et al.* (U.S. Patent No. 6,139,700).**

THE EXAMINER ERRED IN REJECTING CLAIMS 16-18 AND 20 UNDER 35 U.S.C. 103(a) BECAUSE *KANG, ET AL.* (6,139,700) DOES NOT TEACH OR SUGGEST BULK DEPOSITING TUNGSTEN ON A REFRACTORY METAL NUCLEATION LAYER FORMED BY SERIALY EXPOSING A SUBSTATE TO FIRST AND SECOND REACTIVE GASES, WHEREIN TUNGSTEN IS CONTAINED IN ONE OF THE FIRST AND SECOND REACTIVE GASES.

Claims 16-18 and 20 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Kang, et al.* (6,139,700) on grounds that *Kang, et al.* teaches a method comprising forming a refractory metal nucleation layer, WN, by serially exposing the substrate to first and second reactive gases, wherein the refractory metal nucleation layer covers the via, and forming a bulk deposition layer of the refractory metal tungsten on the nucleation layer (column 6, lines 13+). Applicants respectfully traverse the rejection.

Kang, et al. describes a process comprising forming a WN metal barrier layer on a substrate by atomic layer deposition using a tungsten containing precursor (column 2, line 65+). However, *Kang, et al.* does not describe or suggest bulk depositing a tungsten layer on the WN metal barrier layer, as asserted by the Examiner. The Examiner is relying on *Kang, et al.*'s description of a cluster tool that includes a W (tungsten)-CVD chamber (column 6, lines 13+) to assert that *Kang, et al.* discloses bulk depositing tungsten on the WN metal barrier layer and filling vias with the bulk deposition as *Kang, et al.* does not otherwise discuss chemical vapor or bulk deposition of tungsten.

In the Advisory Action mailed May 23, 2005, the Examiner states that it is an aluminum bulk layer that is taught in *Kang, et al.* (column 6, lines 13-15), and admits

that the W-CVD chamber of *Kang, et al.* could “POSSIBLY” (capitalization provided by the Examiner) be used to deposit the conductive layer 16 underneath the WN barrier layer 18 of *Kang, et al.* (Figures 1A-1C), as noted by Applicants in their Response to the Final Office Action dated May 2, 2005. The Examiner also states that the W-CVD chamber of *Kang, et al.* could “POSSIBLY” (capitalization provided by the Examiner) be used for depositing a bulk layer. The Examiner further notes that one of ordinary skill in the art would implicitly know that the W-CVD chamber could be used for bulk depositing a layer because W bulk deposition layers are well known in the art.

Applicants respectfully submit that the Examiner’s speculation that the W-CVD chamber of *Kang, et al.* could be used for depositing a bulk W layer that fills vias or alternatively for depositing a layer underneath a nucleation layer does not support finding that *Kang, et al.* actually teaches or even suggests depositing a bulk tungsten layer as part of a method including forming a nucleation layer by a serial deposition process using a first and second reactive gas, wherein one of the first and second reactive gases includes tungsten, and then bulk depositing tungsten on the nucleation layer to fill a plurality of vias.

Therefore, Applicants maintain that *Kang, et al.* does not teach or suggest a method for forming a nucleation layer and a bulk deposition layer on a substrate having a plurality of vias, said method comprising forming a refractory metal nucleation layer by serially exposing said substrate to first and second reactive gases, wherein the refractory metal nucleation layer covers the plurality of vias, and forming a bulk deposition layer on said nucleation layer by employing vapor deposition to bulk deposit a refractory metal contained in one of said first and second reactive gases, wherein the bulk deposition layer fills the plurality of vias, and wherein the refractory metal is tungsten, as recited in proposed claim 16. Applicants respectfully request withdrawal of the rejection of claim 16 and of claims 17, 18, and 20, which depend thereon.

2. **Argument with respect to the rejection of claim 19 under 35 U.S.C. § 103(a) over *Kang, et al.* (U.S. Patent No. 6,139,700) in view of *Kang, et al.* (U.S. Patent No 6,287,965).**

THE EXAMINER ERRED IN REJECTING CLAIM 19 UNDER 35 U.S.C. 103(a) BECAUSE *KANG, ET AL.* (U.S. PATENT NO. 6,139,700) IN VIEW OF *KANG, ET AL.* (U.S. PATENT NO 6,287,965) DOES NOT TEACH OR SUGGEST BULK DEPOSITING TUNGSTEN ON A NUCLEATION LAYER FORMED BY SERIALY EXPOSING A SUBSTATE TO FIRST AND SECOND REACTIVE GASES, WHEREIN TUNGSTEN IS CONTAINED IN ONE OF THE FIRST AND SECOND REACTIVE GASES AND THE FIRST REACTIVE GAS IS DIBORANE.

Claim 19 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over *Kang, et al.* (U.S. Patent No. 6,139,700) in view of *Kang, et al.* (U.S. Patent No 6,287,965) on grounds that it would have been obvious to use the WBN layer formed by atomic layer deposition in *Kang, et al.* (U.S. Patent No 6,287,965) in place of the WN layer of *Kang, et al.* (U.S. Patent No. 6,139,700) and that it would have been obvious to use a boron-containing compound to supply the boron of the WBN layer. The Examiner acknowledges that *Kang, et al.* (U.S. Patent No 6,287,965) does not state that the B of the WBN layer is provided by diborane or any other boron-containing compound. Applicants respectfully traverse the rejection.

Claim 19 includes the limitations of claim 16 and further recites that the first reactive gas is diborane (B_2H_6). As discussed above in Argument 1, *Kang, et al.* (U.S. Patent No. 6,139,700) does not teach or suggest bulk depositing a tungsten layer on a nucleation layer deposited from a precursor comprising tungsten. *Kang, et al.* (U.S. Patent No 6,287,965) describes depositing metal layers having a A-B-N structure by atomic layer deposition, wherein A may be selected from a group of compounds including tungsten, B may be selected from a group of compounds including boron, and N is nitrogen (column 2, lines 18-37). *Kang, et al.* (U.S. Patent No 6,287,965) does not name diborane or any other boron-containing compounds and does not describe depositing a bulk tungsten layer on a nucleation layer. As neither *Kang, et al.* (U.S.

Patent No. 6,139,700) nor *Kang, et al.* (U.S. Patent No 6,287,965) teach or suggest bulk depositing a tungsten layer on a nucleation layer deposited from a precursor comprising tungsten, *Kang, et al.* (U.S. Patent No. 6,139,700) and *Kang, et al.* (U.S. Patent No 6,287,965), individually or in combination, do not provide or suggest all of the limitations of claim 19. Applicants respectfully request withdrawal of the rejection of claim 19.

3. **Argument with respect to the rejection of claims 23 and 26 under 35 U.S.C. § 103(a) over *Kang, et al.* (U.S. Patent No. 6,139,700) in view of *Kang, et al.* (U.S. Patent No 6,287,965).**

THE EXAMINER ERRED IN REJECTING CLAIMS 23 AND 26 UNDER 35 U.S.C. 103(a) BECAUSE *KANG, ET AL.* (U.S. PATENT NO. 6,139,700) IN VIEW OF *KANG, ET AL.* (U.S. PATENT NO. 6,287,965) DOES NOT TEACH, SHOW, OR SUGGEST BULK DEPOSITING A REFRACTORY METAL ON A NUCLEATION LAYER, WHEREIN THE REFRACTORY METAL IS CONTAINED IN ONE OF A BORON-CONTAINING COMPOUND AND A TUNGSTEN-CONTAINING COMPOUND USED TO DEPOSIT THE NUCLEATION LAYER.

Claims 23 and 26 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Kang, et al.* (U.S. Patent No. 6,139,700) in view of *Kang, et al.* (U.S. Patent No. 6,287,965) on grounds that it would have been obvious to use the WBN layer formed by atomic layer deposition in *Kang, et al.* (U.S. Patent No 6,287,965) in place of the WN layer of *Kang, et al.* (U.S. Patent No. 6,139,700) and that it would have been obvious to use a boron-containing compound to supply the boron of the WBN layer. Applicants respectfully traverse the rejection.

While *Kang, et al.* (U.S. Patent No. 6,139,700) describes depositing WN layers, *Kang, et al.* (U.S. Patent No. 6,139,700) does not teach or suggest depositing nucleation layers using a boron-containing compound and a tungsten-containing compound or depositing a bulk layer comprising a refractory metal from a boron-containing compound or a tungsten-containing compound on a nucleation layer deposited from the boron-containing compound and the tungsten-containing compound. *Kang, et al.* (U.S. Patent No 6,287,965) provides layers that may include boron, but does not teach or suggest depositing a bulk layer comprising a refractory metal from a boron-containing compound or a tungsten-containing compound on a nucleation layer deposited from a boron-containing compound and a tungsten-containing compound.

Thus, *Kang, et al.* (U.S. Patent No. 6,139,700) and *Kang, et al.* (U.S. Patent No. 6,287,965), individually or in combination, do not teach, show, or suggest a method for

forming a nucleation layer and a bulk deposition layer on a substrate disposed in a processing chamber, said method comprising forming a refractory metal nucleation layer by serially exposing said substrate to a boron-containing compound and a tungsten-containing compound, wherein serially exposing said substrate to the boron-containing compound and the tungsten-containing compound comprises exposing said substrate to the boron-containing compound for a period of time, exposing said substrate to a pulse of the tungsten-containing compound, and exposing said substrate to a pulse of the boron-containing compound, and forming a bulk deposition layer on said nucleation layer by employing vapor deposition to bulk deposit a refractory metal contained in one of said boron-containing compound and tungsten-containing compound, as recited in claim 23. Applicants respectfully request withdrawal of the rejection of claim 23.

Also, *Kang, et al.* (U.S. Patent No. 6,139,700) and *Kang, et al.* (U.S. Patent No 6,287,965), individually or in combination, do not teach, show, or suggest a method for forming a nucleation layer and a bulk deposition layer on a substrate disposed in a processing chamber, said method comprising forming a refractory metal nucleation layer by serially exposing said substrate to a boron-containing compound and a tungsten-containing compound, wherein serially exposing said substrate to the boron-containing compound and the tungsten-containing compound comprises exposing said substrate to a pulse of the boron-containing compound, exposing said substrate to a pulse of the tungsten-containing compound, and exposing said substrate to the boron-containing compound for a period of time, and forming a bulk deposition layer on said nucleation layer by employing vapor deposition to bulk deposit a refractory metal contained in one of said boron-containing compound and the tungsten-containing compound, as recited in proposed claim 26. Applicants respectfully request withdrawal of the rejection of claim 26.

CONCLUSION

For the reasons presented above, Appellants respectfully submit that the rejections of claims 16-20, 23, and 26 under 35 U.S.C. § 103(a) are improper. Reversal of the rejections of the claims is respectfully requested.

Respectfully submitted,



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CLAIMS APPENDIX

1-15. (Canceled)

16. (Previously Presented) A method for forming a nucleation layer and a bulk deposition layer on a substrate having a plurality of vias, said method comprising:

forming a refractory metal nucleation layer by serially exposing said substrate to first and second reactive gases, wherein the refractory metal nucleation layer covers the plurality of vias; and

forming a bulk deposition layer on said nucleation layer by employing vapor deposition to bulk deposit a refractory metal contained in one of said first and second reactive gases, wherein the bulk deposition layer fills the plurality of vias, and wherein the refractory metal is tungsten.

17. (Previously Presented) The method of claim 16 wherein the bulk deposition layer is deposited employing chemical vapor deposition.

18. (Previously Presented) The method of claim 17 wherein the refractory metal nucleation layer and the bulk deposition layer are deposited in the same chamber.

19. (Previously Presented) The method of claim 16 wherein the first reactive gas is diborane (B_2H_6).

20. (Previously Presented) The method of claim 19 wherein the second reactive gas is WF_6 .

21-22. (Canceled)

23. (Previously Presented) A method for forming a nucleation layer and a bulk deposition layer on a substrate disposed in a processing chamber, said method comprising:

forming a refractory metal nucleation layer by serially exposing said substrate to a boron-containing compound and a tungsten-containing compound, wherein serially exposing said substrate to the boron-containing compound and the tungsten-containing compound comprises:

exposing said substrate to the boron-containing compound for a period of time;

exposing said substrate to a pulse of the tungsten-containing compound;
and

exposing said substrate to a pulse of the boron-containing compound; and
forming a bulk deposition layer on said nucleation layer by employing vapor deposition to bulk deposit a refractory metal contained in one of said boron-containing compound and tungsten-containing compound.

24-25. (Canceled)

26. (Previously Presented) A method for forming a nucleation layer and a bulk deposition layer on a substrate disposed in a processing chamber, said method comprising:

forming a refractory metal nucleation layer by serially exposing said substrate to a boron-containing compound and a tungsten-containing compound, wherein serially exposing said substrate to the boron-containing compound and the tungsten-containing compound comprises:

exposing said substrate to a pulse of the boron-containing compound;
exposing said substrate to a pulse of the tungsten-containing compound;
and

exposing said substrate to the boron-containing compound for a period of time; and

forming a bulk deposition layer on said nucleation layer by employing vapor deposition to bulk deposit a refractory metal contained in one of said boron-containing compound and the tungsten-containing compound.

27-33. (Canceled)

EVIDENCE APPENDIX

No evidence is submitted.

RELATED PROCEEDINGS APPENDIX

No copies of decisions rendered by a court or the Board in a related appeal or interference are included as no related appeals or interferences have been identified.